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IMPROVED ODOR CONTROL CASSETTE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a flexible tubing for use in a cassette dispenser for a diaper or similar waste disposal device. More particularly, the present invention relates to barrier films used for flexible tubing in such cassettes.

2. Description of the Prior Art

Diaper disposal devices have become popular for the convenient and sanitary disposal of diapers and related waste. A conventional diaper disposal device has a pail that serves as a storage chamber accessed via a closable lid and, a cassette positioned in the pail and having a tubular core with a length of flexible tube stored in the core. The diaper disposal system operates by depositing a soiled diaper into the pail, rotating the core, and twisting the flexible tube to create a seal above the

diaper. A second diaper may be disposed of by opening the lid, inserting the second diaper, and pushing the previous sealed diaper further into the storage chamber. A new seal is created by twisting the tube above the newly deposited diaper. The process can continue until the pail is filled. Consequently, the device stores the discarded diapers in a series of individually wrapped packages in the storage chamber. Each package is separated from adjacent packages by twists in the tubing. Such a packaging and disposal system is described in U.S. Patent No. 5,813,200, assigned to Playtex Products, Inc., the assignee of the present invention. A cassette for use in a diaper disposal system is described in U.S. Patent No. 4,934,529 to Richards et al., also assigned to Playtex Products, Inc.

Diaper disposal containers, in addition to aiding in the discrete and sanitary disposal of human waste, also provide a method of reducing malodor by containing the waste in sealed packages of flexible tubing. The flexible tubing currently employed in the art is formed of a substantially air-impermeable material such as Formosa E905 or Formosa FPC. However, the odor reduction capability of a tubing formed of Formosa resin is limited by its

permeability. Over time, a significant amount of odiferous gas permeates through the tubing material into the environment. Less permeable materials have not been employed in the art because they are ill-suited for the conversion process in which film from a roll is inserted into a cassette. Less permeable materials are brittle and the insertion process creates splits or openings in the film. Such splits are axially formed, as a result of the molecular orientation of the film during the blowing process. Also, the rigidity of less permeable materials renders them ill-suited to the twisting required for operation of a cassette.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a flexible tube or tubing material for use in a cassette of a waste disposal system.

It is another object of the present invention to provide such a cassette in which the flexible tube has barrier properties that substantially reduce malodor from discarded diapers.

It is still another object of the present invention to provide a flexible tube material for use in a cassette of a waste disposal system that is resistant to tearing and splitting.

It is a further object of the present invention to provide such a flexible tube material that is inexpensive and easy to manufacture.

These and other objects and advantages of the present invention are provided by the use of a flexible tube material for use in a cassette of a waste disposal system, in which the flexible tube material has both improved odor control capabilities and enhanced tear strength. The tube material of the present invention is made of a high density polyethylene (HDPE) film resin that exhibits a low melt index in combination with a high molecular weight. The HDPE film resin exhibits both (1) odor barrier properties by reducing the amount of odiferous gas that may penetrate the film, resulting in better odor control, and (2) enhanced or higher tear strength, enabling the HDPE material's functionality in a cassette.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and still other objects and advantages of the present invention will be more apparent from the following detailed explanation of the preferred embodiments of the present invention in connection with the accompanying drawings.

Fig 1 illustrates the cell set-up for the isostatic permeation test; and

Fig. 2 illustrates organic transmission rate test results.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is described in the context of a cassette for use in a disposal system, preferably a diaper disposal pail or system. However, the dimensions and design of the cassette may be modified to accommodate any waste material having an unpleasant odor. Other such applications may include use in a trash can, a medical waste receptacle, or a chemical waste receptacle.

The cassette tube or tubing material has improved odor control capabilities and enhanced tear strength. The cassette tube material is formed of a high density polyethylene film resin that exhibits a low melt index in combination with a high molecular weight. These attributes insure that both barrier properties and tear strength are retained. The melt index of the tube material is in the range of 0.04 g/10 min to 0.50 g/10 min, and preferably is 0.10 g/10 min. The density of the tube material is in the range of 0.90 g/cm^3 to 0.99 g/cm^3 and preferably is 0.95 g/cm^3. Additionally, the tube material has an Elmdorf tear strength, in the range of 9g to 20g, and preferably 10g, in the molded direction, and in the range of 30g to 400g, and preferably 100g, in the direction transverse to the mold direction. The tube material also has a tensile strength at break, of 7,000 psi to 13,000 psi, and preferably 10,000 psi, in the molded direction, and 6,000 psi to 10,000 psi, and preferably 9,000 psi, in the direction transverse to the mold direction. Also, the tube material has an elongation at break, of 250% to 500%, and preferably 400%, in the molded direction, and 300% to 700%, and preferably 500%, in the direction transverse to the mold direction.

Tube materials were selected based on the results of the isostatic organic permeation study described in the Example below.

The HDPE resin material selected for the tubing, with a density in the range of 0.90 g/cm^3 to 0.99 g/cm^3, has large molecules that, when incorporated into a film, leave gaps smaller than those of conventional tube materials, thereby reducing the amount of odiferous gas that may penetrate the film. The result is better odor control and maximized barrier protection when used in a cassette.

The tube material has increased tear strength, in addition to a high molecular weight, enabling its use in an improved odor control cassette. Normally, as polyethylene density increases (to achieve higher modulus) other properties, such as tear strength, decrease. However, the tube material of the present invention has enhanced or high or increased tear strength, as well as high molecular weight. These characteristics enable the tube material to withstand twisting and insertion dynamics, without resultant breakage, that is necessary to the function of the cassette.

The film made from the resin material disclosed has a thickness in the range of 7μm to 30μm, depending on whether the film is manufactured as an infant film or toddler film. Toddler film is typically thicker than infant film, thereby providing superior barrier properties.

The film is blown to a lay-flat dimension via a blown film process. The gauge was kept constant thereby increasing barrier properties. The reduced gauge offers the opportunity for reduced raw materials, shipping and storage costs for the tubing material. Additionally, an increased amount of tubing can be fitted into each cassette, thereby prolonging use. A further benefit to the use of a HDPE resin material for cassette tubing is that HDPE is less expensive to manufacture than nylon materials typically employed in a cassette.

One commercially available HDPE material suitable for use in an improved odor control cassette is known as Alathon® XL5906 HDPE resin, marketed by Equistar. This HDPE is described in U.S. Patent Nos. 5,962,598 and 6,147,167, both assigned to Equistar, and both patents are

incorporated herein by reference. Alathon® XL5906 HDPE possesses the following typical properties:

Property	Test Method	Units	Value
Density	ASTM D-1505	g/cm^3	0.959
Melt Index	ASTM D-1238	g/10 min	0.057
Elmdorf Tear Strength, MD(TD)	10(34)	g	D1922
Tensile Strength @ Break, MD(TD)	12,300(9,360)	psi	D822
Elongation @ Break, MD(TD)	300(350)	%	D822
Secant Modulus, MD(TD)	181,000(186,000)	psi	D822

Another suitable, commercially available linear polyethylene material is known as HiD® 9650 Blown Film Resin, marketed by Chevron. HiD® Blown 9650 Film Resin possesses the following typical properties:

Property	Test Method	Units	Value
Density	ASTM D-1505	g/cm^3	0.952
Melt Index	ASTM D-1238	g/10 min	0.034
Elmdorf Tear Strength, MD(TD)	16(400)	g	D1922
Tensile Strength @ Break, MD(TD)	50,990(43,410)	psi	D822
Elongation @ Break, MD(TD)	460(650)	%	D822
Secant Modulus, MD(TD)	709,670(826,800)	psi	D822

It should be noted that the odor control capabilities of the HDPE film used in the cassette may be enhanced by the addition of one or more deodorizers and/or fragrances. Additionally, for aesthetic reasons, the HDPE film may have a color or a design printed thereon.

EXAMPLE

An organic permeation study was undertaken to provide barrier characteristics of various films for human fecal matter. This data was developed by performing an isostatic transmission rate study.

The organic compounds shown in Table 1 were combined in equal amounts by volume. The multi-component mixture and the films were placed in a remote cell as illustrated in Figure 1. The top sides of the films were continuously swept with a nitrogen carrier gas in order to prevent any decrease in concentration gradient across the film.

Table 1

Table 1 shows the organic permeants used for the permeation study.

COMPOUND	CLASS
1-Pentanethiol	C5 mercaptan
Valeric acid	C5 organic acid
p-cresol	Substituted phenol
Indole	Aromatic heterocycle

The carrier gas stream was periodically monitored to determine whether equilibrium had been reached. Once equilibrium was achieved, the results were recorded. A MOCON ARMATRAN II equipped with a capillary column and a flame ionization detector (FID) was used for the analysis.

After all test films had reached equilibrium and the results had been recorded, the measuring instrument was calibrated to the four individual organic permeants: 1-Pentanethiol, valeric acid, p-cresol, and indole. A three-point calibration was used for each permeant.

The film was challenged with the permeant on one side, while the flux from the other side is swept to a liquid nitrogen cooled cryo-trap. The flux was concentrated in the cryo-trap and then flashed into a capillary column where the individual components were separated. The components were then quantified at the FID and the results were recorded. The transmission rate was calculated based on the component quantification, the area of sample, and the accumulation time in the cryo-trap.

A baseline was determined prior to the permeation study in order to isolate the permeants in question. The results are given for oxygen, water vapor and organic molecule transmission. For the results shown, the Chevron HiD® 9650 and Equistar XL5903 films exhibited the best barrier properties. Commercially used films, such as Formosa E905, Formosa FPC and Chevron 9640, behaved in a manner similar to one another and the co-extruded multiple layer CX film exhibited the worst barrier properties.

Table 2

Table 2 shows the organic transmission rate results.

FILM	Transmission rate (μl/m^2-day)				
	1-Pentanethiol	Valeric acid	p-cresol	Indole	TOTAL
CX	9.22×10^6	3.11×10^4	3.27×10^4	6.84×10^5	9.97×10^6
Formosa E905	4.34×10^6	8.25×10^3	2.55×10^4	3.56×10^5	4.73×10^6
Formosa FPC	4.39×10^6	8.89×10^3	2.81×10^4	5.33×10^5	4.96×10^6
Chevron 9640	4.51×10^6	6.18×10^3	2.70×10^4	2.61×10^5	4.80×10^6
Chevron 9650	3.03×10^6	1.94×10^4	2.72×10^4	2.28×10^5	3.30×10^6

Fig. 2 is an illustration of the organic transmission rate test results, which shows that the Chevron HiD® 9650 film has superior barrier properties as compared to the Formosa films currently used in Diaper Genie cassettes. Fig. 2 further shows that Equistar XL5903 also has superior barrier properties as compared to the Formosa films.

Equistar Alathon® XL5906 HDPE resin has similar properties to Equistar XL5903 and, therefore, similarly provides improved barrier properties when compared with Formosa films. A separate study was undertaken to demonstrate the improved barrier of the Equistar Alathon® XL5906 HDPE resin as compared to the Formosa E905 film using pentanethiol as a permeant. The results are shown below in Table 3.

Table 3

Film	Pentanethiol Transmission rate ($\mu l/m^2$-day) at 23°C
Formosa E905	28.63 x 107
Equistar Alathon® XL906	19.59 x 107

The Formosa E905 film produced a transmission rate of 28.63 x 107 $\mu l/m^2$-day at 23°C. In contrast, the Equistar Alathon® XL906 produced a transmission rate of 19.59 x 107 $\mu l/m^2$-day at 23°C. The Equistar Alathon® XL906 produced substantially less transmission of pentanethiol and, therefore, has superior barrier properties compared to the Formosa E905 film.

The present invention has been described with particular reference to the preferred embodiments. It should be understood that the foregoing descriptions and examples are only illustrative of the invention. Various alternatives and modifications thereof can be devised by those skilled in the art without departing from the spirit and scope of the present invention. Accordingly, the present invention is intended to embrace all such alternatives, modifications, and variations that fall within the scope of the appended claims.